

## The Commercial Production of Seeds of Flowers

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SEEDS OF SOME 1,500 varieties of flowers are available to amateur gardeners in the United States. The major part of the acreage on which they are grown is devoted to producing about 750 of them. The value of the seeds is about 2.5 million dollars. Five genera produce seed crops valued at more than 100 thousand dollars each.

The acreage for flower seeds thus comprises small plantings of many crops—an acre of this, half an acre of that. By usual farming standards, it is manicured acreage that requires the best level, irrigated land.

The income per acre is two to five times that of beans, for example, but costs of production are correspondingly higher. More than 40 percent of the cost is for field labor, which must be of such manual skill that good work approaches a craft status.

Each species of flower grown for seed has its own planting time, culture, problems of pollination, and harvesting technique, but there is one basic requirement for good seed production: A mild climate with little rain during the growing and harvesting seasons. The United States industry therefore is concentrated in California.

Less favorable conditions result in uncertain and usually lower yields and germination percentages, although colder climates are suitable for some annuals and many perennials. Colorado, Oregon, Washington, Texas, Illinois, Indiana, Ohio, New York, New Jersey, and other States produce some seeds of flowers.

To engage in the production out-

doors of rowcrop flower seeds, by far the largest poundage of the industry, the flower-seed farmer should have ability, prime acreage, a source of skilled labor, and a suitable climate. Greenhouse production is independent of location, having its own "California" climate tailor-made, but it is an entirely different business.

The growing of flower seeds in the United States dates from the early 1800's. The experience and planting stock came from Europe at first. The industry was well established in New York State by the time California came into production about 1880, but the advantages of drier climates had shifted most of the production west by the First World War, and the United States became a major producer of flower seeds. By 1949 five firms, all in California, were growing 75.6 percent of the crop value of the Nation.

The structure of the industry is one of farmers selling to wholesalers, who then sell to retailers, since only 6.3 percent of the sales represent retailing by the farmer. The wholesalers themselves, however, are major producers of what they sell. They operate their own farms and contract only in areas or on crops that are not suited to their organization.

The reasons therefor lie in the nature of the crops of flower seeds.

Many of the kinds represent highly hybridized strains, on which elite (or foundation) planting stock must be planted anew each year—not crop seed planted back. The wholesaler almost invariably produces this stock himself, on his own farm, which incorporates research breeding work and trial grounds, to keep pace with the rapidly changing technology of the industry.

Elite strains require planning and supervision to insure their pedigree and uniform cultural practices to insure the maximum salable crop. Buyers have specific standards of varietal purity and germination in mind when they buy, which is not on a daily bid basis but on annual contract, usually

in advance. The wholesaler has to deliver seed of these standards, grown under his supervision.

GENERALLY SPEAKING, most annuals require as much time between first flowering and good seed production as they need from planting to the first flush of bloom. Species that can be grown for flower production in short-summer locations almost anywhere in the world are not necessarily seed crops in those locations.

Quick-blooming, tender annuals, such as zinnias, need 6 frost-free months for seed formation, although a light frost does not harm the harvest. Others require 8 to 11 months.

Half-hardy annuals may be started before all danger of frost is past and summer harvested, but even with them the requirement of a long spring season eliminates many hard-winter locations from consideration for reliable production.

Few places in the world have the Mediterranean climate needed to grow the variety of flower crops of a major seed producer. California is high on the list. Planting there is continuous from November to May (one species following another on the schedule), and harvesting extends from June to December. Spring-blooming annuals are usually the first in and off, but stocks, for example, need a season of 11 months.

Rain is beneficial before flowering. Rain later encourages fungi in the seed head and reduces the yield. Rain on the mature seed lowers germination percentages. Nevertheless, most sections of semiarid climate, even in latitudes where frost is not a problem, may not be suitable for seed farms because high summer temperatures also reduce yield of seed of all but a few annuals.

PRODUCTION in California is mainly in the cool Lompoc, Santa Maria, and Salinas Valleys for this reason, but zinnias and others (basically of Central American origin) may be cropped in

the Los Angeles area and on the edges of the hot inland valleys.

Biennials and perennials are grown in cold-winter areas for seed production but even they do best in a mild climate. When they are grown in California, they are handled as 2- or 3-year plantings because, without killing frosts, both plants and their diseases are rampant.

All crops in California require extensive irrigation during the summer. A common practice is to withhold the water at the end of the season to encourage rapid and uniform maturing of the seed crop. Ditch irrigation is general. Overhead systems are used seldom.

Flower-seed farming has its special problems, and those who can master them tend to be seed farmers year after year.

The plants usually grow so slowly, for example, that weed control is a major problem. Chemical weedkillers are popular, but the man with a hoe is still the mainstay. Most fields need complete hand weeding three times or more a season; sometimes it is combined with thinning in drilled crops. Petunias and many others usually are transplanted to the field by hand, because mechanical transplanters cannot handle such small, fragile seedlings.

MECHANICAL mixing of harvested plants is prevented by alternating plantings of species to be harvested at different times of the year.

Special field-labeling techniques are used to identify lots going through the cutting and threshing process to avoid seed mixing. Mixed lots are nearly worthless in an industry where high prices are paid only for pedigree seed.

The many small plots of closely related kinds on one farm mean that one crop may be unintentionally cross-pollinated by another of the same species, rendering the resulting seed virtually useless.

Unintentional fertilization by "foreign" pollen is insidious because there is no visible mixing.

Pollination is, however, what makes the wheels go in the seed business. The high acre yields of sweetpeas in California, for example, are partly due to the constant winds, which jostle the flowers of this strictly self-pollinated species. In most other kinds, self- and cross-pollination are accomplished by insects, which cannot distinguish between several named colors of sweet alyssum, for example, so that such plantings must be isolated from each other. Strict isolation by as much as one-fifth mile sometimes is necessary.

When the grower lays out two fields of different colors or of double- and single-flowered varieties, he must consider the result of a possible cross: Which condition will be dominant in the result? Perhaps he can turn this into an advantage; maybe he will get a new kind of flower or one that the competition cannot reproduce. Hybrid marigolds are an example. All such decisions require the skills of a geneticist.

The emphasis on varietal purity is not solely the concern of flower men in the seed industry, but only they set out deliberately to produce mixed varieties. Only in flower seed can a mixture of colors of one kind be a salable or even highly desirable product. Many times this mixture is blended of named colors in the warehouse, according to formula, but field-grown mixtures are the rule when named colors have not yet been tried up or when there is an advantage to controlled cross-pollination of colors, such as added vigor in the final product.

Because the crop will be sold long before a check sample can be flowered next year, every result of this cross-pollination must be predicted in advance: Does one color outyield the others? Then adjust the planting formula to reflect this. Does a cross between red and white yield all-red, all-white, or some of each (perhaps even intershades)? Then make sure to plant enough of the recessive color to assure many self-pollinations of that color. Does one color mature earlier than another? Then choose the har-

vesttime carefully, or one color will dominate the mixture because of this factor.

FOOD AND FIBER CROPS of survival interest to man have been grown for so many centuries that their climatic adaptability is great; even those grown for their seeds produce the same under similar conditions. Flower crops, being primarily of esthetic interest, are late-comers in the selection process and still retain many preferences for a specific environment and no other.

Flower-seed farmers have learned that climates, even microclimates, must be charted carefully. The economic benefit of finding the right location for a crop in California, for example, can easily outweigh the advantage of much lower wages and costs of growers of the same item in other countries.

In the 1940's, for example, the seed yield of larkspur was trebled by moving the crop a distance of 8 miles.

Precipitation in these two places, Lompoc Valley and the adjacent Santa Rosa area, was the same; humidity was a few points drier; and the temperatures perhaps averaged four degrees higher in Santa Rosa. The result was that the new area produces the major part of our larkspur seed. In the competitive flower seed industry, the search for new microclimates is continuous, and wholesalers keep detailed records on each production area, new and old.

Visitors to the flower farms are amazed that much flower seed is harvested and threshed by machinery of the sort used for grain. Even the fine seed of petunia is handled so. Hand picking or cutting saves more seed, but high labor costs and the need for speed dictate mechanical methods whenever possible. Crops are harvested occasionally with a combine, but much more commonly the plants are cut and windrowed until they can dry to a moisture content suitable for machine threshing.

The diversity of crops leads to several cutting methods. Nasturtiums may be

windrowed on the ground. Species with seed heads that shatter at a touch must go onto large canvas sheets.

The stems of petunia plants are so sticky that, even though the seed shatters out of the capsule, a significant amount of it adheres to the stem and can be saved if the whole plant is put on sheets to dry. Only early-rising visitors see the cutting operation, which is carried out when the morning dew is on the plants to avoid loss of the dry seeds. The drying period varies according to the weather, but usually is 10 to 20 days. Rain at this time is catastrophic.

Regardless of the trend toward mechanization, a major part of harvesting is still handwork, either in preparation or finishing. In perennials such as delphinium, several handpickings precede the final cutting because the plants have a long flowering period and seed production is continuous.

Zinnias are commonly handpicked, and the flower heads must be flat rolled preparatory to threshing, as the seeds stick tenaciously to the central cone.

RECLEANING is basically the same operation as in the rest of the seed industry. Fanning mills, specific gravity separators, disk and roller separators, and occasionally flotation are used.

The difference with flower seeds lies in the multiplicity of small lots, which necessitate short machine runs and scrupulous cleaning of the machinery between each run. The high wholesale value makes for extreme care and elaborate recordkeeping. The dimensions of the recleaner's job can be illustrated by the fact that more than 4 million petunia seeds weigh a pound (sometimes worth as much as 100 dollars); a pound of sweetpea seeds has about 500 seeds, worth perhaps 70 cents. Screens, sieves, disks, and such to handle all shapes and sizes are essential.

RELATIVE AIR humidity has an important bearing on the curing of flower seed in the field. Generally speaking, the lower it is, the better. One of the

reasons why production is concentrated in California is that normal drying may be accomplished entirely under natural conditions, and California seed is famous for its high initial germination and long keeping qualities. Up to 1958, practically no artificial drying machinery was used in the industry; then it was introduced to extend the already excellent keeping qualities of the California product.

A large part of United States production is processed to the optimum moisture content for long-term storage and sealed in moisture-vapor-proof containers so that retailers in "wet" climates can count on the vigor, vitality, and keeping qualities of the seeds as originally harvested.

THE GREATEST change in the American flower seed industry since the Second World War is the expansion of greenhouse production. It stems from the application of the  $F_1$  hybrid principle to give garden and florist plants tremendously greater vigor and productivity.

Petunias are the most important greenhouse crop of flower seeds in dollar value. The reason is that some colors (scarlet and coral) and forms (doubles and 100-percent large-flowered singles) can be had only as hybrids grown in the greenhouse. The essence of the production of  $F_1$  hybrid seed is the development of unique parent strains for use in a specific and controlled cross. The research work involved is such that only well-organized seed firms are in a position to initiate or contract production. The crop requires a supervisor with the equivalent technical education of the flower breeder.

Production is under a glass or plastic cover. Plastic is used in summer or the whole year in California. Usually even the ventilators are screened to keep out insects that might bear contaminating pollen. The sanitary precautions to prevent disease are formidable.

The seed parent (female) is pot or bench grown. The anthers and stamens

of each flower are removed before it opens. The procedure is called emasculation. The pollen parent is grown elsewhere, and its pollen is gathered when it is ripe.

The pistil of the seed parent is receptive about a week after emasculation, and pollen from the male parent is applied to fertilize the flower. In 6 weeks the seed capsule has matured. Then it is harvested by hand.

Production is continuous on each plant, which may produce hundreds of flowers during its useful life. (Petunias and antirrhinums, or snapdragons, are first-year-blooming perennials, but disease and forced seed production result in a useful plantlife of only 5 months.)

Production is measured in ounces per thousand plants. Few of the dozens of varieties on the market reach a production rate of 100 ounces a year or more, but the value of that amount exceeds 10 thousand dollars at wholesale.

The problems in this type of seed production may center around disease (which is always a danger with pot-grown plants weakened by forced seedling), pollen contamination, plant nutrition, temperatures, humidities, light intensities, and the growth or productivity quirks of parent lines seemingly identical with their sisters. Labor availability and utilization, effective supervision, and the ever-present concern with product quality are more akin to manufacturing than to farming.

AN INSPECTION of seed catalogs and the advertisements of retail seedsmen indicate the drive that flower seed producers have to produce new, unique, and improved varieties every year.

Some notable contributions have been made by amateurs—for example, McKana's aquilegia, which won an All-America award—but the main body of this work is carried on by the wholesalers, large and small, of flower seeds. A large company will budget up to 5 percent of its annual income to research work.

The introduction of new varieties

before the Second World War depended primarily on line selection, a method still basic, particularly in maintaining the highly bred standard strains. The typical novelty developed in this way used to require about 10 years from idea to finished product.

Improved techniques, which yield more than one generation in a year, and better knowledge of the behavior of the plant material have cut the development time to an average of 5 years. The  $F_1$  hybrid technique, however, not only in petunias and antirrhinums but in a widening array, including marigolds and zinnias, has increased the number of new items marketed each year.

People who grow flower seed form a rather exclusive "club" (350 of them in 1960), whose initiation may be complicated but whose education is likely to be one of the broadest in agriculture. Independent people with a lively interest in many things and skills are drawn in, not particularly to get rich (although salaries totaled 900 thousand dollars in 1960), but because competence is widely respected in the industry and pride of craftsmanship is strong. Many new cultural, chemical, and genetic techniques, which eventually find application in the seed trade as a whole, are pioneered by the workers in this small, highly skilled industry.

More than 25 million American families plant flower seeds each year, for a total of many millions of hours of gardening pleasure. Some of them may give little thought to whether the seeds are better than what their parents planted. The flower seed people, however, give the matter a lot of thought: Most of them do indeed love flowers, but not uncritically; they are dedicated to producing the very best strains, and next year they will be better than that.

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